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Filter Device

The invention relates to a filter device with at least one filter element which can be held in a filter housing, which can be connected to carry fluid by way of fluid connections to a fluid means, especially in the form of a hydraulic tank, by means of a connecting device.

These filter devices are readily available on the market in a plurality of designs and versions. Among their functions is to filter dirt in fluids, such as hydraulic oil, out of these fluids. Hydraulic oil is fouled during installation and when the respective hydraulic system is started up, and in addition to this initial fouling, fouling during operation can occur, for example by penetration of dirt at the hydraulic tank due to inadequate tank ventilation, pipe penetrations, piston rod seals, and the like. To the extent fouling within the fluid stored in the hydraulic tank occurs in hydraulic systems of machines such as earth moving machines, excavators or the like, it can be advantageous to implement filtration directly in the area of the hydraulic tank, for example by attaching the filter device directly to the tank, and the hydraulic oil which is removed from there is delivered directly to a filter element to filter out dirt which filter element is held in the filter housing, and the fluid which has been cleaned in this way then returns again to the tank by way of the filter housing. Here add-on solutions are known in which the filter device cleans only the contents of the tank; but solutions

are also conceivable in which the filter device delivers the correspondingly filtered and cleaned fluid to the hydraulic circuit of the machine, in order from there to return to the tank the fluid which is also fouled with solid particles in the pertinent circulation in the hydraulic circuit.

In the solutions in which the filter device filters only the contents of the tank, in which fluid is removed from the tank, filtered and then returned again to the tank, it can be advantageous to avoid interruptions in the operation of the respective hydraulic system, to block off the contents of the fluid means, especially in the form of a hydraulic tank, relative to the filter housing, in order to replace a fouled and used filter element by a new one, or for purposes of changing this filter element to completely dismount the filter housing with the used filter element from the fluid means in the form of the tank. After appropriate maintenance of the unit of the filter housing with the filter element, especially by replacement of the used filter element by a new one, this unit can be re-connected to the fluid means for use. It is also possible to connect a new unit of the filter housing with the unused filter element to the fluid means, while in the other, already described dismounted unit the filter element is changed. For this reason, in the known solutions the pipes must be separated from each other in a complicated manner, sealed, and by way of complex rotary slide valve parts the fluid connection between the fluid means (tank) and the filter housing with the filter element must be separated and later re-connected, the indicated rotary slide valve parts as a component of a connecting means between the filter housing and the fluid means being not only expensive to produce and complicated to maintain, but also entailing the danger that correspondingly large amounts of fluid will emerge from the fluid means as a leaking oil flow; this leads to fouling problems in the vicinity. These solutions are also prone to failure in operation, and in this regard less reliable, since an operator often has problems at the assumed position of the rotary slide valve parts in recognizing whether they are in their blocking or in their open position.

On the basis of this prior art, the object of the invention is to further improve the filter devices as claimed in the invention such that they meet the above described requirements for their

operation in a space-saving and reliable manner with low production, installation and maintenance costs. This object is achieved by a filter device with the features specified in claim 1 in its entirety.

In that, as specified in the characterizing part of claim 1, the connecting means is provided with at least one longitudinally displaceable blocking part which blocks the fluid connection which can be assigned to it in the blocking position, and after displacement into the open position clears it again, a type of blocking slide valve solution is implemented which makes it possible to block or clear the indicated fluid connections with only a brief actuation process in order to change the filter element for the used filter medium and to re-use the filter element stored in the filter housing for the filtration tasks under consideration. Since it can be seen from the outside of the blocking slide valve which operating position it is in, it is also evident to an operator which operating position the filter device currently assumes. Based on the configuration of the blocking part as a longitudinally displaceable blocking slide valve, it requires little installation space and in this way can also be easily used for cramped installation conditions. The linear displacement motion of the blocking part can be mechanically controlled easily and effectively; on the one hand this helps reduce the production, installation and maintenance costs, and on the other reliable operation for the connecting device as the blocking and clearance means even under difficult ambient conditions is achieved.

With the filter device as claimed in the invention, it is possible to separate the unit formed from the filter element and the filter housing from the remaining fluid means in a fluid-tight manner, in order to replace the used filter element with a new one on site, that is to say, on the fluid means; but by preference the possibility also exists of completely removing this unit from the fluid means, and to replace the element elsewhere, and then additional maintenance operations can be carried out. The indicated change of the element takes only seconds, and with the solution as claimed in the invention it is also ensured that fluid (oil) cannot escape to the exterior; this could otherwise lead to environmental pollution.

Other advantageous embodiments of the filter device as claimed in the invention are the subject matter of the other dependent claims.

The filter device as claimed in the invention will be described in detail using one exemplary embodiment as shown in the drawings. The figures are schematic and not to scale.

FIG. 1 shows as a cross-sectional view the important components of the filter device, the unit consisting of the filter housing and filter element being separated from the fluid means;

FIG. 2 shows a representation corresponding to FIG. 1, in the assembled state;

FIG. 3 shows in a perspective view the filter device as shown in FIGS. 1 and 2, the representation which is the left one viewed in the direction of looking at FIG. 3 corresponding to FIG. 1, and the right-hand representation corresponding to FIG. 2, the middle representation reproducing the intermediate position.

The filter device shown in the figures has a cylindrical filter element 10 of conventional design. The filter element 10 is used to filter dirt, especially in the form of solid particles, out of a fluid flow, such as a hydraulic medium. For this purpose the filter element 10 is provided with a preferably pleated filter mat 12 which is supported on the interior on a perforated support tube (not shown). Furthermore the filter mat 12 which is made cylindrical is held between two end caps 14, 16. This element structure is conventional and prior art, so that it will not be detailed here. The upper end cap 14 can be equipped in addition with a bypass means, for example a bypass valve (not shown) in order in this way to ensure that when the filter element 10 is clogged with dirt the fluid flow can freely pass the filter element 10 via the end caps 14, 16 in order to avoid obstacles in operation of a fluid or hydraulic system. The lower end cap 16 viewed in the direction of looking at

FIG. 1 is held along one cylindrical mounting connection piece 18, and is sealed via a gasket 20 against the latter.

In this regard the filter element 10 can be held in a cylindrical filter housing 22 by way of the mounting connection piece 18. To replace the fouled filter element 10 by a new filter element 10, the filter housing 22 on its top has a removable cover part 24 which is otherwise sealed against the interior of the remaining filter housing 22 by way of another gasket 26. The essentially cylindrical filter housing 22 tapers downward viewed in the direction of looking at FIG. 1, and in the area of this taper 28 has a fluid connection 30 which is connected to the interior of the filter element 10 to carry fluid via the mounting connection piece 18. Furthermore, the longitudinal axis 32 of the fluid connection 30 assumes a right angle to the longitudinal alignment or longitudinal axis 34 of the filter housing 22. There is another fluid connection 36 with a longitudinal axis 38 which is located on top and likewise perpendicular to the longitudinal axis 34 of the filter housing 22. The diameters of the two fluid connections 32, 36 correspond to each other, the fluid connection 30 forming the fluid outlet and the other fluid connection 36 forming the fluid inlet of the filter device. The dirty fluid flows via the fluid inlet 36 into the interior of the filter housing 22 and from there flows from the outside to the inside through the filter element 10 with its filter mat 12. Any dirt in the fluid flow, especially in the form of solid particles, then adheres to the filter mat 12, and the fluid which has been cleaned in this way travels via the interior of the filter element 10 and via the mounting connection piece 18 to the side of the fluid connection 30 and accordingly to the outlet side of the filter device.

The two fluid connections 30, 36 can be connected to a fluid means, especially in the form of a hydraulic tank 40; in the figures, of the hydraulic tank 40, only one part in the form of the front connecting plate 42 is shown. By means of a connecting device identified as a whole as 44, the unit consisting of the filter housing 22 in addition to the filter element 10 can be coupled to the fluid means, preferably in the form of a hydraulic tank 40, and detached again. The connecting means 44

is provided with a blocking part 46 which can be displaced in the longitudinal direction and which in the blocking position (compare FIGS. 1 and 3, left and middle) blocks the respective assignable fluid connection 30, 36, and after moving into the open position (compare FIGS. 2 and 3, right) clears these fluid connections 30, 36.

The blocking part 46 is made as a plate-shaped sliding valve part which is guided sealed between the front connecting plate 42 and another connecting plate 48 of the connecting device 44 by means of a sealing device 50. As already described, one connecting plate 42 is facing the fluid means or the tank 40, and the other, second connecting plate 48 faces the unit consisting of the filter housing 22 in addition to the filter element 10. Both the sliding valve part and also the two connecting plates 42, 48 are made essentially rectangular. The respective sealing means 50 consists of a conventional ring seal between the respective connecting plates 42, 48 and the sliding valve part which is guided in between in the middle as a blocking part 46. In this regard, the respective sealing device 50 extends annularly around the fluid passages 52, 54 which run in the two connecting plates 42, 48 and which run with their longitudinal axes corresponding to the longitudinal axes 32, 38 of the fluid connections 30 and 36. FIG. 1 which relates to the blocking position of the blocking part 46 shows that these fluid passages 52, 54 are covered by the wall parts 56 thereof and are kept cleared in the open position as shown in FIG. 2.

The two fluid connections 30, 36 of the filter housing 22 are configured in the longitudinal direction of the latter on top of each other in the same manner as the fluid passages 52, 54 in the connecting plates 42, 48 of the connecting device 44. Between the blocking wall parts 56 of the blocking part 46 the latter has in turn clearance openings 58 which are kept cylindrical and which in the open position of the blocking part 46 (compare FIG. 2) are congruent with the fluid passages 52, 54 of the connecting device 44 so as to carry fluid. In this open position the longitudinal axes of the holes of all the connections assigned to each other can be regarded as running in a line so that in this way no unnecessary edges are formed which could possibly lead to cavitation or swirling.

Furthermore, the indicated holes for fluid passage discharge in a common plane, both with reference to the outside contour of the filter housing 22 and also with reference to the outside contour of the connecting device 44. Furthermore, the two fluid connections 30, 36 of the filter housing 22 are each provided with one valve 60, 62, respectively. In this connection the valve disk of one valve 60 located on the fluid outlet 30 projects over the latter to the outside, and the valve disk of the other valve 62 located at the fluid inlet 36 is integrated into it. The respective valve disk opens as shown against the action of the resetting force of a compression spring, the respective valve disk having a convex arch which is pointed against the direction of flow of the fluid to be triggered.

As the figures furthermore show, the fluid connections 30, 36 of the filter housing 22 are surrounded on the outer peripheral side by a flange-like attachment part 64. These attachment parts 64 are used to attach the filter housing 22 to the assignable flange parts 66 of the other connecting plate 49 which faces it, which flange parts encompass the fluid connections 53, 54. In this respect the unit of the filter housing 22 with the filter element 10 can be attached stationary to the connecting device 44 and accordingly to the fluid means in the form of a hydraulic tank 40 by way of a conventional screw connection. Viewed in the direction of looking at FIG. 3, the representation located at extreme left for the upper attachment part 64 has a locking part in the form of a locking pin 68. For passage of this locking pin 68 the other connecting plate 48 which is located foremost viewed in the direction of looking at the figure has a through hole 70 which can be made congruent with a recess 72 in the blocking part 46 as soon as the unit is attached to the connecting device 44 and the sliding valve-shaped blocking part 46 has assumed its open position as shown in FIG. 2 and FIG. 3 at extreme right. In this way, a plausibility check is achieved and operating errors are for the most part precluded, since the unit consisting of the filter housing 22 in addition to the filter element 10 can only be attached when the locking pin 68 has engaged the recess 72 from its free end on the front side. Then the screws of the attachment parts 64 and the flange parts 66 are tightened in order in this way to complete the attachment process. This catching engagement of the locking pin 68

results in the sliding valve-like blocking part 46 not unintentionally traveling into its closed position as shown in FIG. 1.

The blocking part 46, viewed in the direction of looking at the figures, on its top has a handle 74 which forms a through hole into which the operator can fit his hand accordingly. Furthermore the filter housing 22 on its side facing away from the connecting device 44 has another handle 76 in the form of a knuckle bow via which the unit consisting of the filter housing 22 in addition to the filter element 10 can be easily handled by the operator. The filter housing 22 itself consists preferably of an aluminum diecasting and the blocking part 46 can consist of a steel or plastic material.

With reference to FIG. 3, at this point the important operating sequence is detailed with reference to the filter device as claimed in the invention.

Viewed in the direction of looking at FIG. 3 at extreme left, the blocking part 46 in its upper blocking position is as shown in FIG. 1. In this blocking position the continuous wall sections 56 cover the fluid passages 52, 54. On the sides of the fluid means 40 in the form of the hydraulic tank an operating overpressure of for example 10 bar is to prevail. As a result of the spring force support, the valves 60, 62 are closed and the filter housing 22 should have a new, unused filter element 10 with the formation of a new unit. According to the center representation as in FIG. 3, an intermediate position is shown there in which the screws of the attachment parts 64 and the flange parts 66 already engage each other and the locking pin 68 has already penetrated the hole 70 in the connecting plate 48 and with its free end it adjoins the top of the plate-shaped blocking part 46. At this point the blocking part 46 is moved farther down and then assumes its open position as seen in FIG. 3 at extreme right. Since the handle 74 is provided with stop shoulders at the location of the transition to the recess 72, they are positioned on the assigned parts at the top on the connecting plate 48 so that in this respect the blocking part 46 is prevented from being able to slip down out of

the guide which has formed between the two connecting plates 42, 48, and the recess 72 is now positioned such that the locking pin 68 engages as soon as the screw connections are definitively fixed. This operating or open position is reproduced according to the sectional view in FIG. 2. Based on the prevailing fluid pressure on the sides of the fluid means 40, the valve 62 which is uppermost viewed in the direction of looking at FIG. 2 is pushed open and dirty fluid can enter the filter device for a cleaning process through the filter element 10. The cleaned fluid then leaves the filter housing 22 via the other, second valve 60 which opens by the valve disk being pressed in the direction of the fluid passage 52.

For a decoupling process of the unit from the connecting device 44, the indicated attachment processes proceed in the reverse sequence, and the sliding valve-shaped blocking part 46 closes the fluid means 40, conversely the valves 60, 62 enabling reliable closure of the filter housing 22 with its contents relative to the exterior. The used filter element 10 can now be cleaned at another suitable location or optionally can be replaced by a new element. Since the fluid means is blocked against the exterior by way of the blocking part 46, in this respect oil cannot escape from the system to the exterior. In another execution of the solution as claimed in the invention, it is also conceivable to decouple the fluid means from the unit and consequently from the filter housing 22 by way of the blocking part 46, on site, but, that is to say, directly on the equipment, to replace the element after loosening the cover part 24. Furthermore, in place of only one blocking part 46 several blocking parts or sliding valves can also be assigned to each fluid opening and can assume the blocking function. In this respect it is not necessary to shut down the hydraulic system for a replacement or maintenance process.